

## WHAT IS CLAIMED IS:

1. A knocking index value calculation device of a spark ignition engine, comprising a controller functioning to:

determine operating conditions of the engine;

estimate an in-cylinder pressure at a reference crank angle, which is set at a predetermined crank position after compression top dead center, on the basis of the operating conditions;

estimate a temperature of unburned gas in the cylinder at the reference crank angle on the basis of the operating conditions; and

calculate a knocking index value using the in-cylinder pressure and unburned gas temperature.

2. The knocking index value calculation device as defined in Claim 1, wherein the reference crank angle is set to a value within a range of ten to twenty degrees after compression top dead center.

3. The knocking index value calculation device as defined in Claim 1, wherein the controller further functions to:

determine as the operating conditions of the engine an in-cylinder pressure when an intake valve closes, a temperature of the unburned gas in the cylinder when the intake valve closes, and an amount of heat generated by fuel combustion; and

estimate the in-cylinder pressure and unburned gas temperature at the reference crank angle on the basis of the in-cylinder pressure when the intake valve closes, the temperature of the unburned gas in the cylinder when the intake valve

closes, and the amount of heat generated by fuel combustion.

4. The knocking index value calculation device as defined in Claim 1, wherein the controller further functions to correct the knocking index value on the basis of a combustion speed.
5. The knocking index value calculation device as defined in Claim 4, wherein the controller further functions to correct the knocking index value such that the knocking index value decreases as the combustion speed decreases.
6. The knocking index value calculation device as defined in Claim 1, wherein the controller further functions to calculate, on the basis of the knocking index value, an amount of retardation of an ignition timing relating to a minimum advance value for obtaining maximum torque.
7. The knocking index value calculation device as defined in Claim 6, wherein the controller further functions to increase the retardation amount of the ignition timing as the knocking index value increases.
8. A knocking index value calculation device of a spark ignition engine, comprising:
  - means for determining operating conditions of the engine;
  - means for estimating an in-cylinder pressure at a reference crank angle, which is set at a predetermined crank position after compression top dead center, on the basis of the operating conditions;
  - means for estimating a temperature of unburned gas in the cylinder at the

reference crank angle on the basis of the operating conditions; and

means for calculating a knocking index value using the in-cylinder pressure and unburned gas temperature.

9. A knocking index value calculation method, comprising:

    determining operating conditions of a spark ignition engine;  
    estimating an in-cylinder pressure at a reference crank angle, which is set at a predetermined crank position after compression top dead center, on the basis of the operating conditions;

    estimating a temperature of unburned gas in the cylinder at the reference crank angle on the basis of the operating conditions; and

    calculating a knocking index value using the in-cylinder pressure and unburned gas temperature.